



Armed Forces College of Medicine AFCM



Female Reproductive system Ovary

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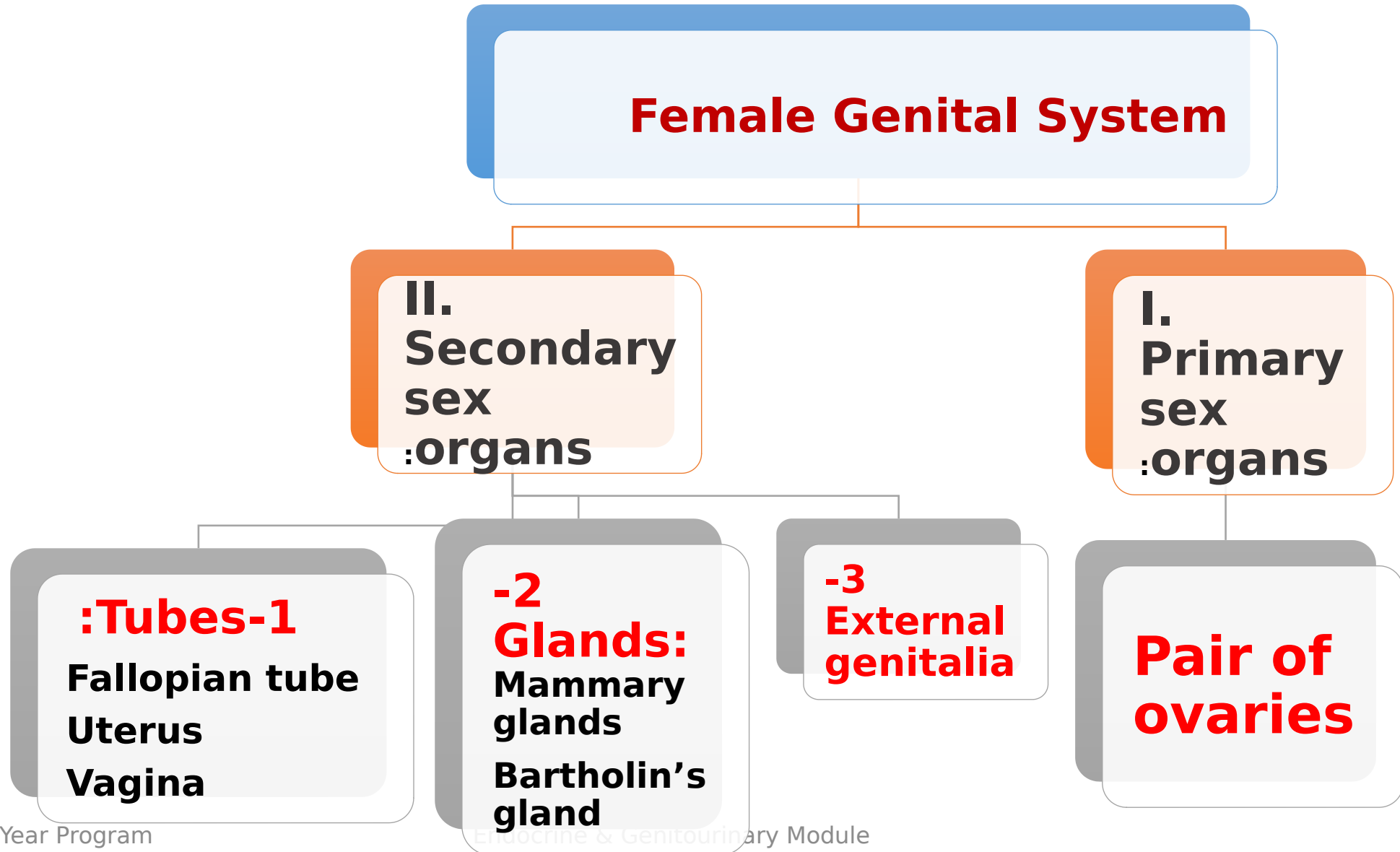
INTENDED LEARNING OBJECTIVES (ILO)

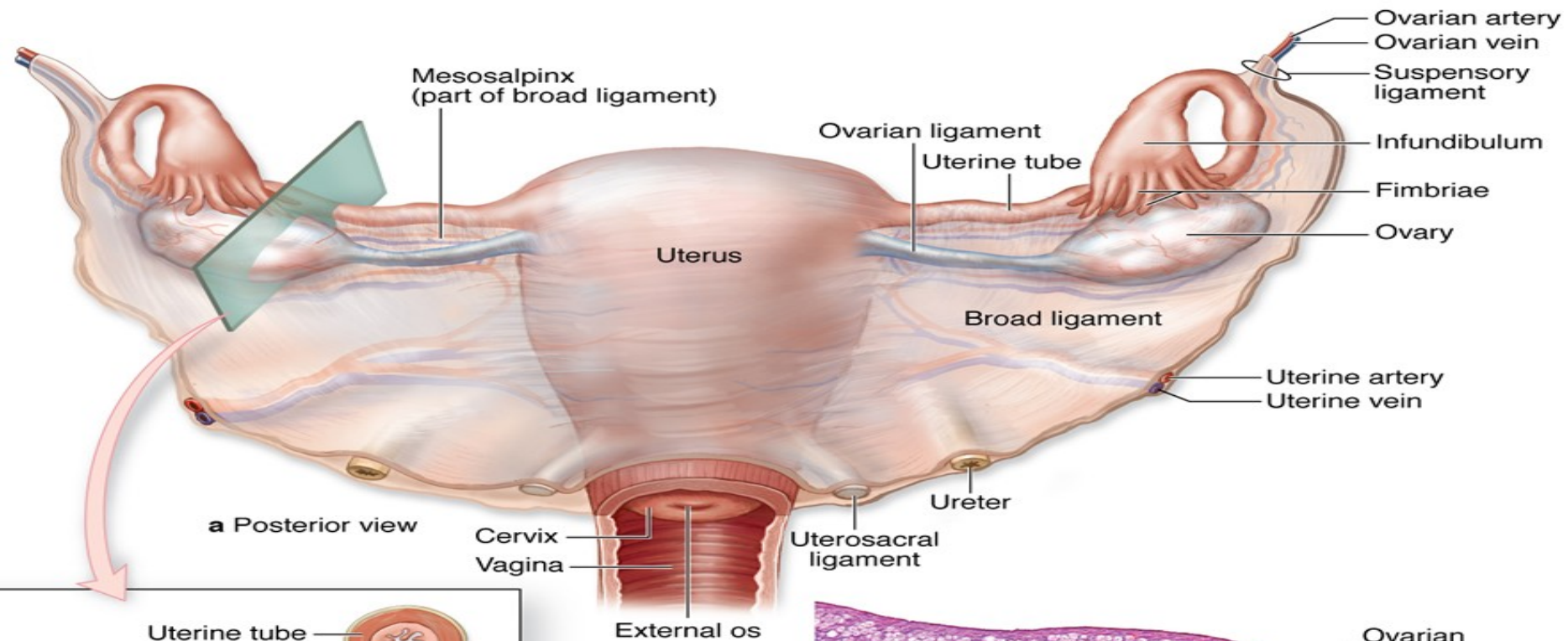


By the end of this lecture the student will be able to:

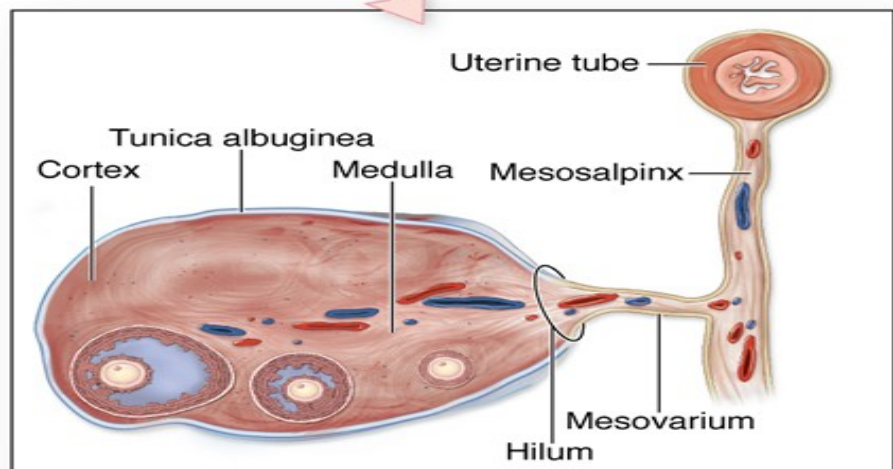
1. Describe the microscopic structure of the ovary and ovarian follicles.
2. Correlate the structure of the follicles to their function.
3. Discuss the histological structure of the ovary during the different phases of the cycle.
4. Interpret the histological changes in the ovary in

Female Genital System

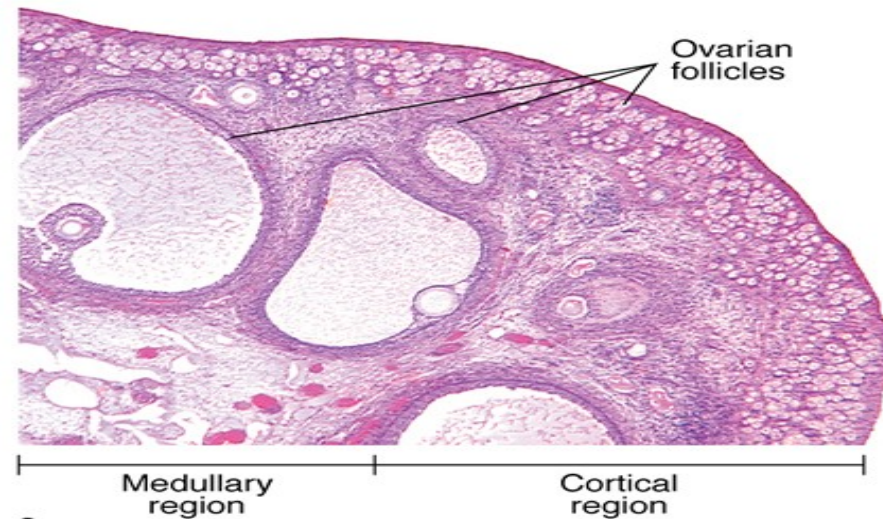




a Posterior view



b Lateral sectional view



c

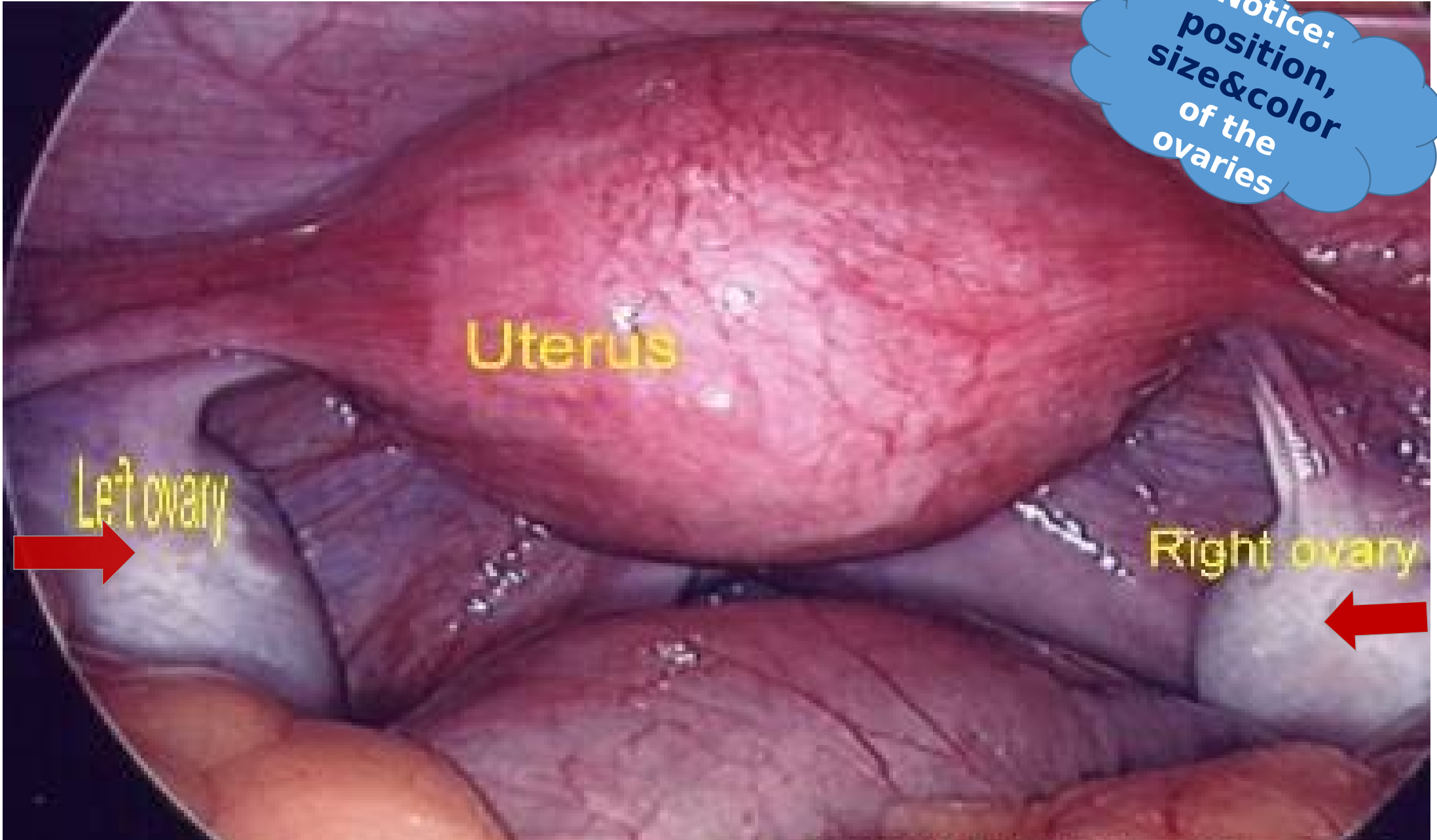
Notice:
position,
size&color
of the
ovaries

Uterus

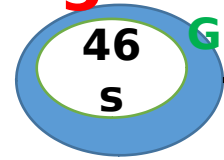
Left ovary



Right ovary



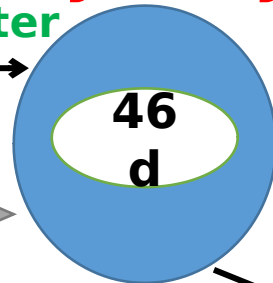
oogonia



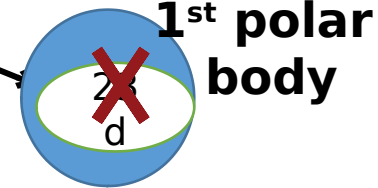
Growth at 2nd trimester

1ry oocyte

(enter prophase of 1st meiotic division)



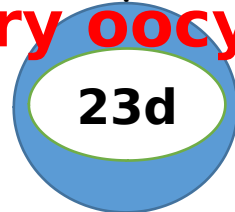
just
before
ovulation



1st polar
body

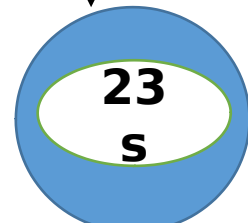
1st meiotic division is completed

2ry oocyte



Enter 2nd meiotic division and arrested at metaphase

After
fertilization



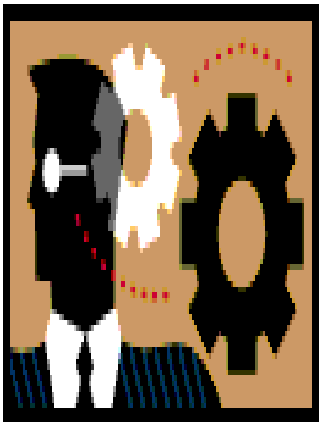
Mature ovum

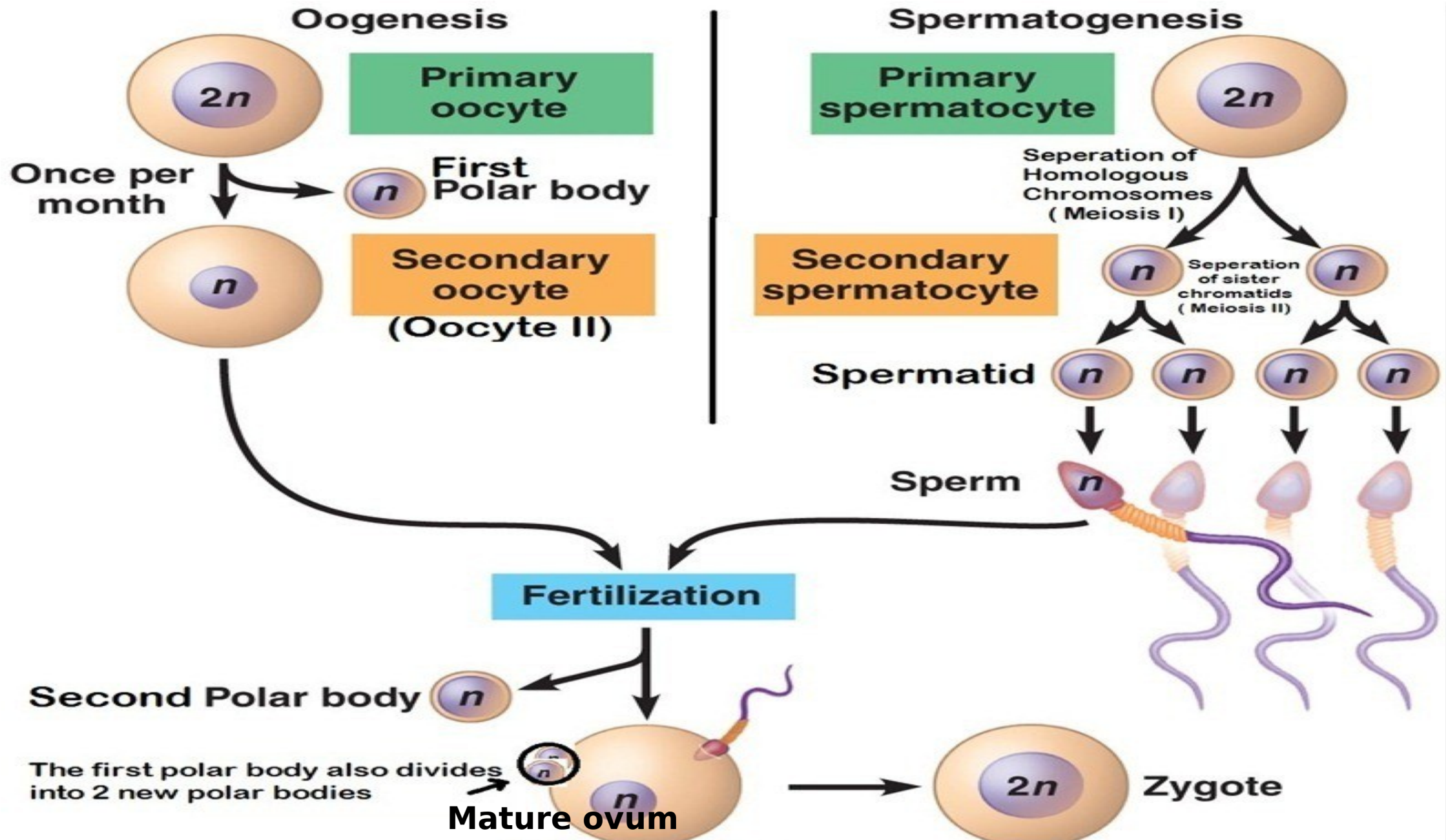


2nd polar
body

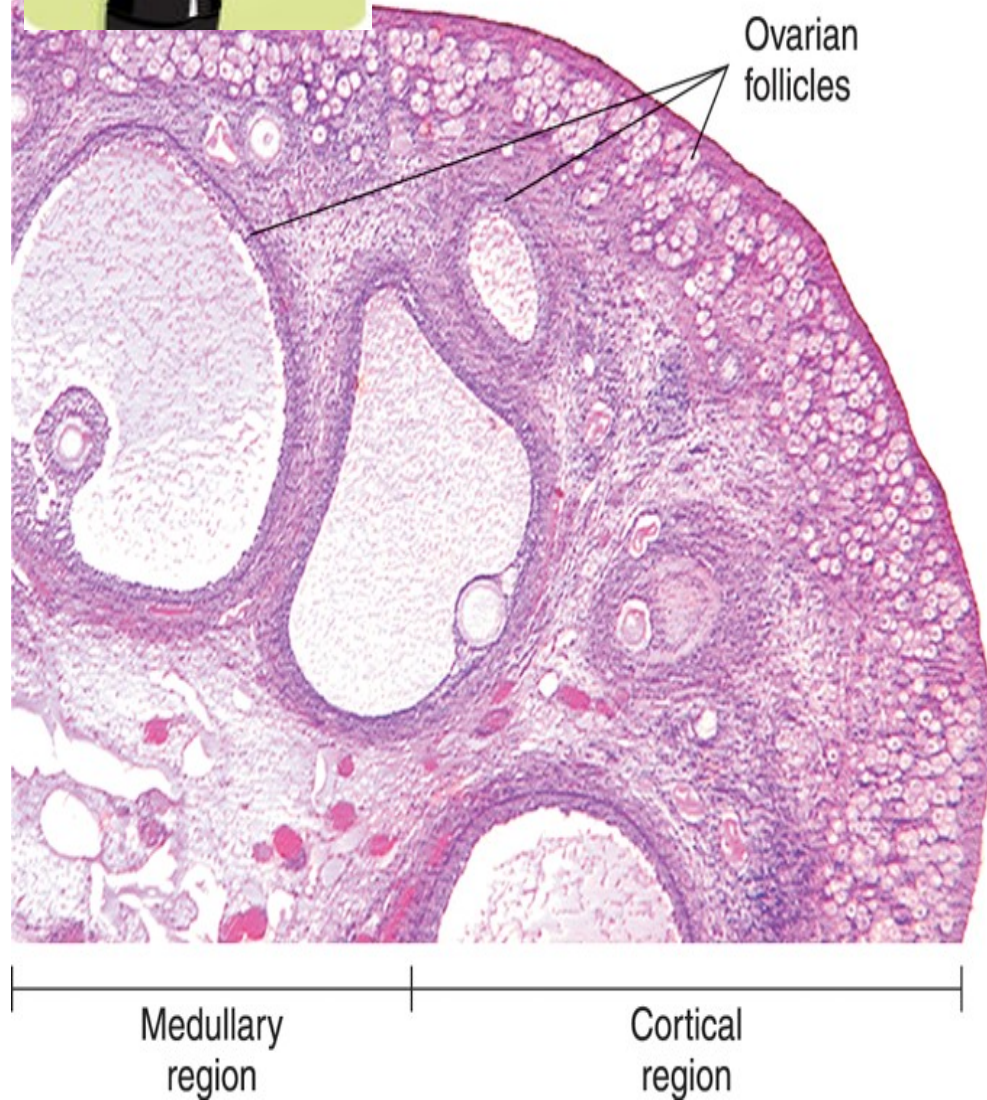
ACTIVITY

✓ Difference between Spermatogenesis and Oogenesis





THE OVARY



➤ They are paired ovoid almond shaped bodies (**$3 \times 1.5 \times 1$ cm**).

➤ Ovaries are **mixed glands**:

Exocrine
Endocrine

Mature ovum
Estrogen &

Progesterone

➤ **Section in the ovary**

Structure of the ovary

```
graph TD; A[Structure of the ovary] --> B["-A  
Stroma"]; A --> C["B-  
Parenchyma  
in cortex)  
(only)"]; B --> D[Stroma of Cortex]; B --> E[Stroma of Medulla]; C --> F["Ovarian follicles  
And its possible fates"]; C --> G[Interstitial glands];
```

-A
Stroma

**Stroma
of
Cortex**

**Stroma
of
Medulla**

B-
Parenchyma
in cortex)
(only

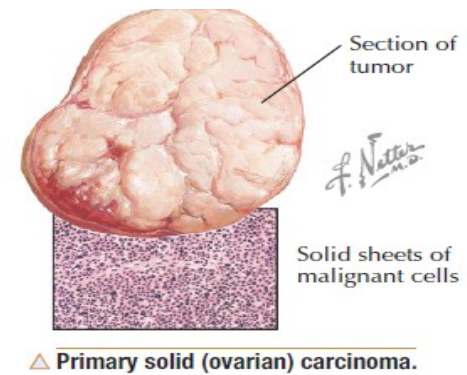
**Ovarian
follicles**
And its
possible fates

**Interstitia
l glands**

A- Stroma of the ovary

>70%
of
ovarian
cancer

I. Stroma of the cortex



1. Germinal epithelium → instead of mesothelium

covers the ovary:

White
discoloration
of the ovary

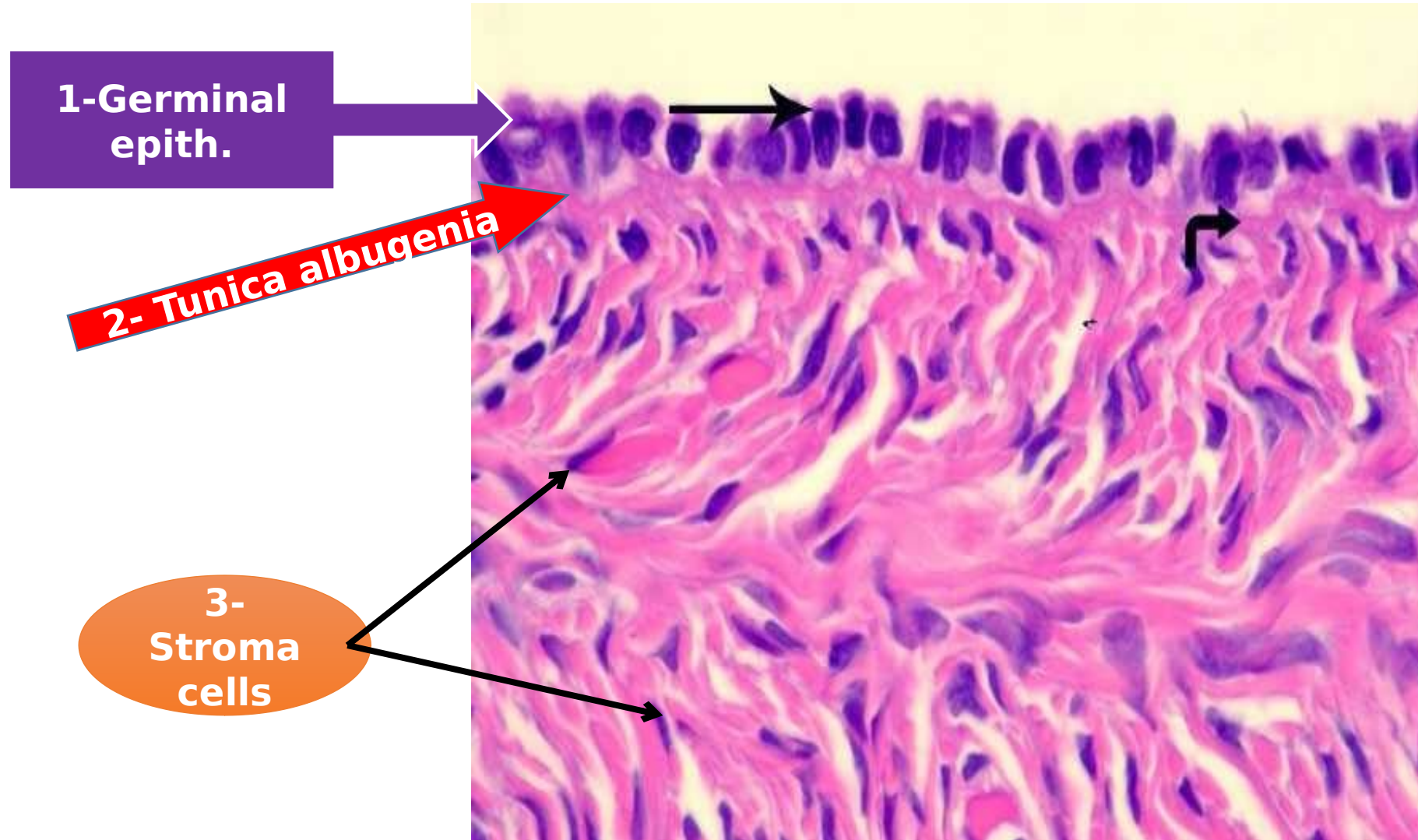
It is cubical or flat epithelium.

2. Tunica albuginea (dense C.T. layer)

Give rise to
theca
folliculi

3. Reticular C.T. composed of groups of spindle shaped *stroma cells* (fibroblast like cells) arranged in whorl-like pattern, collagen fibers and reticular fibers

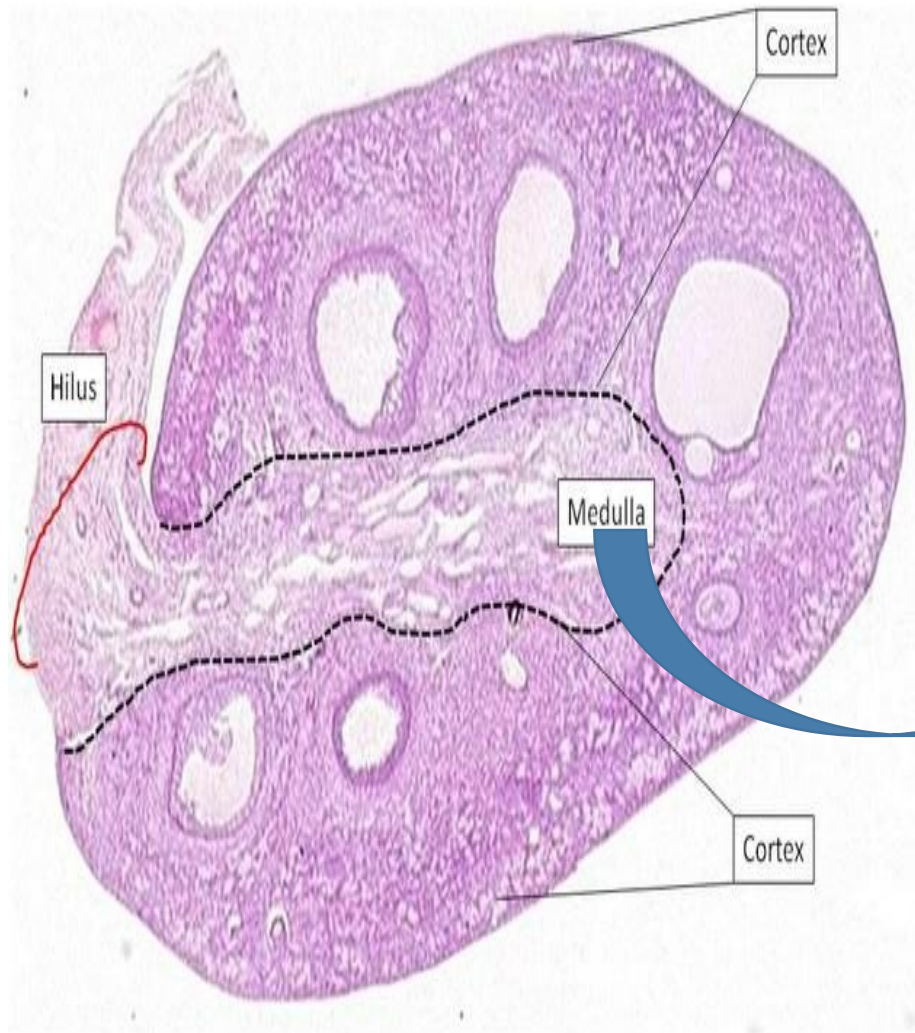
Stroma of the cortex



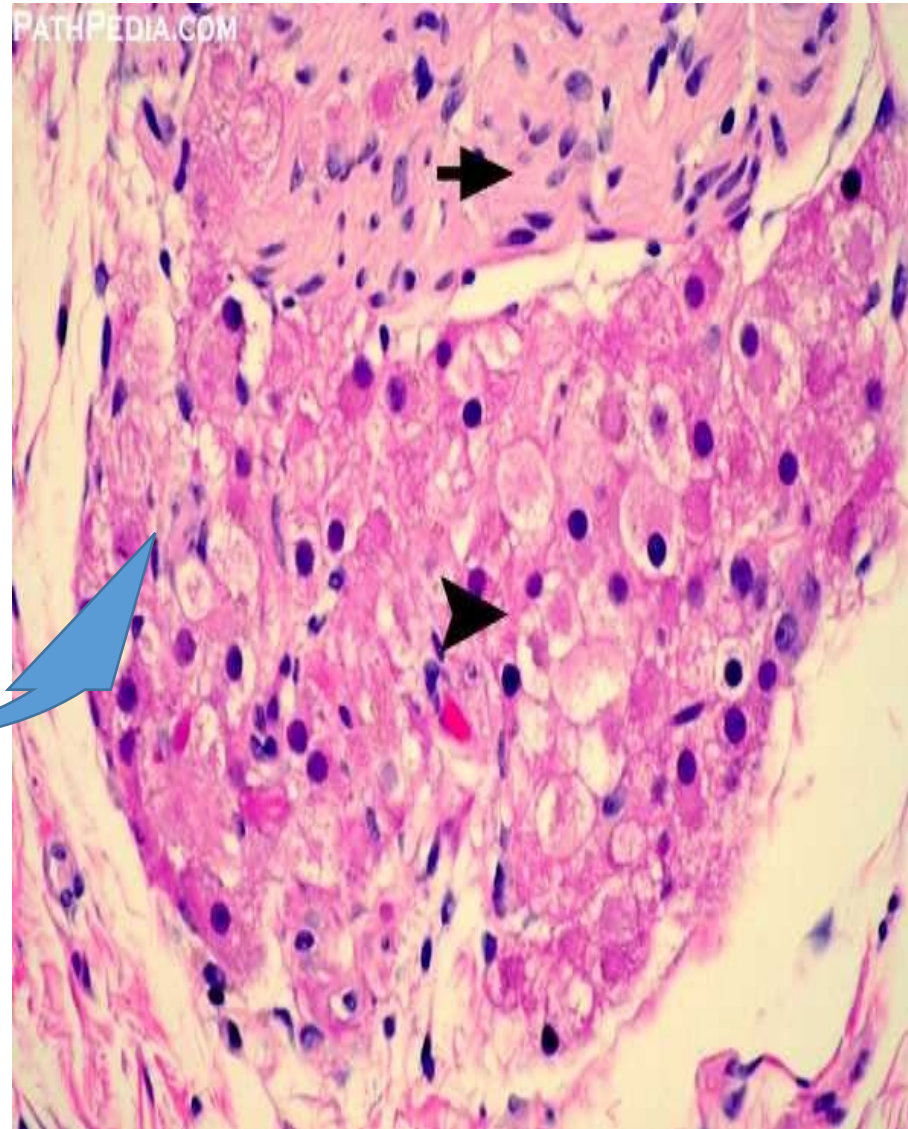
II. Stroma of the medulla

- It constitutes the central region of the ovary.
- Loose highly vascular C.T.
- Hilus cells are epithelioid cells similar to Leydig cells of the testis (steroid secreting cells and contain Reinke crystals).
- Hilus cells secrete androgens

Ovary

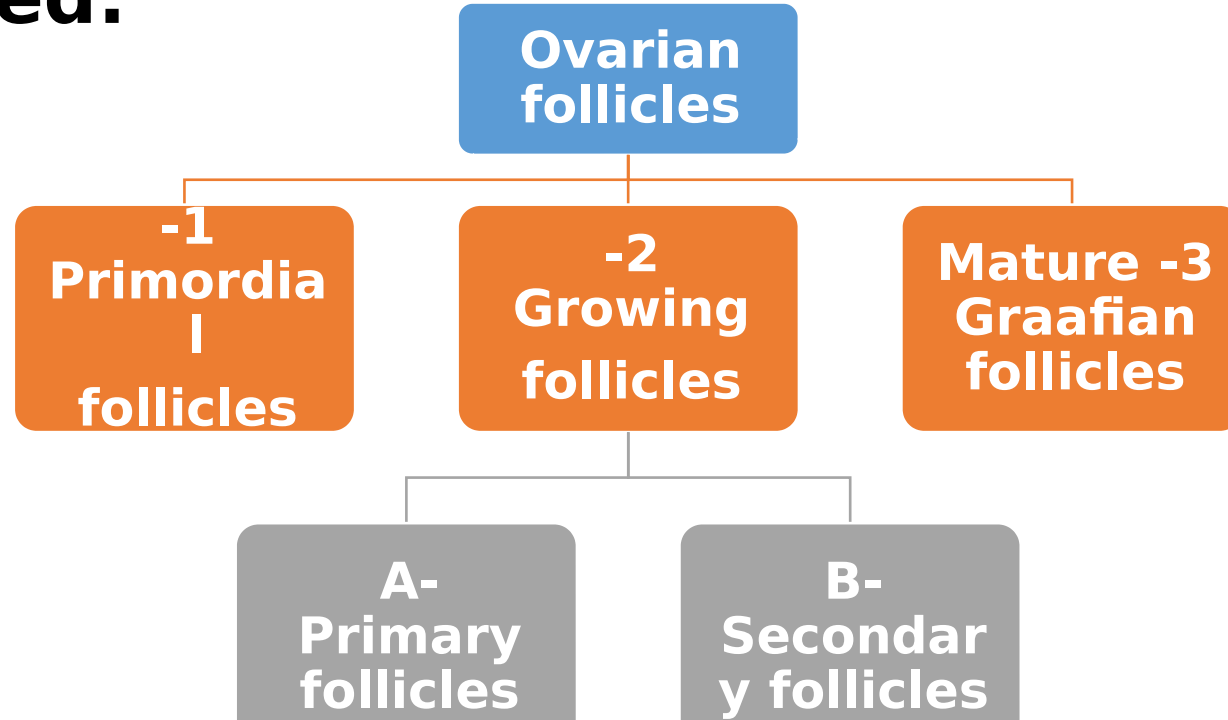


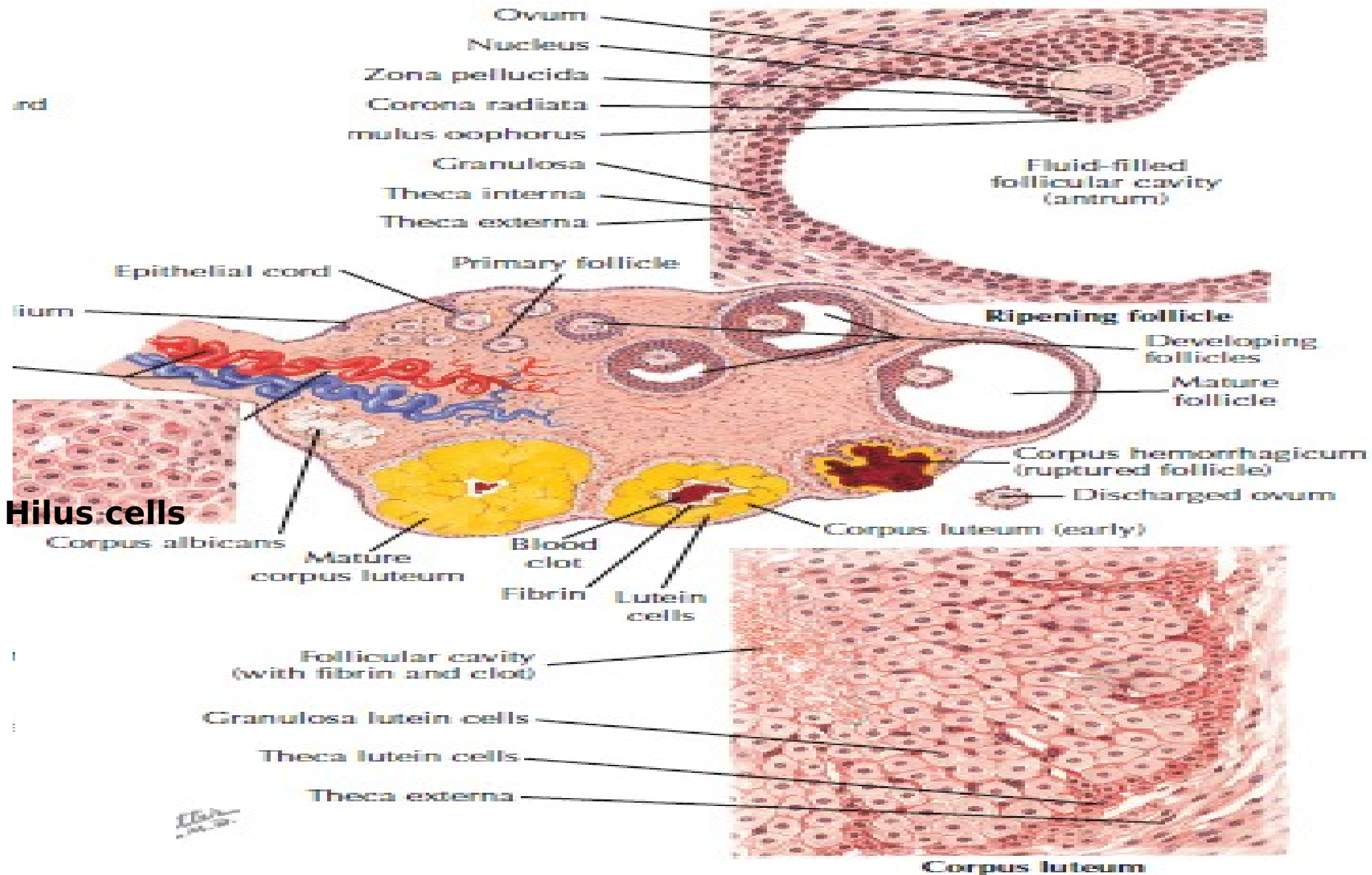
Hilus cells



B- Parenchyma of the ovary

- Ovarian follicles provide the **microenvironment for the developing oocyte.**
- They are present in cortex of the ovary.
- Histologically, 3 basic types of ovarian follicles can be identified:





1- Primordial follicles

- They are the principle and the only follicle present **since birth until prior to puberty**
- Site: under tunica albuginea
- No.: about 400,000
- Each follicle is formed of:
 - I- **Primary oocyte**
 - II- **Flattened follicular cells (one layer)**

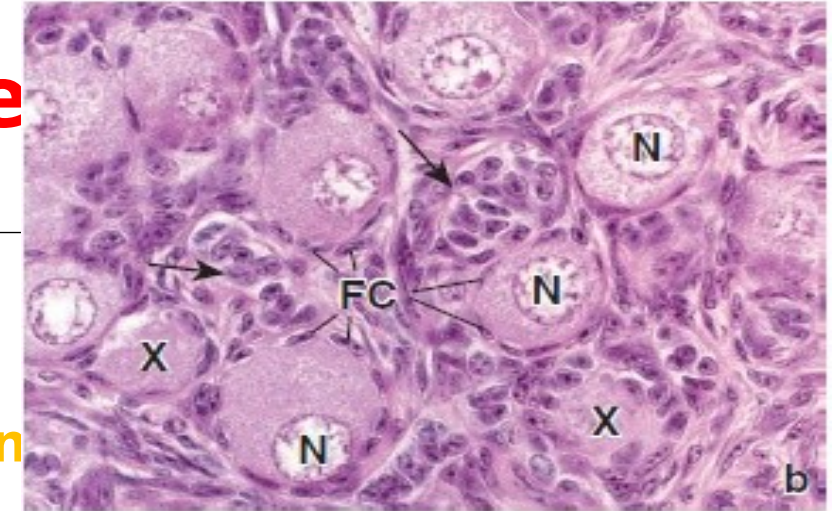


Primordial follicle

I- Primary oocyte (46-d-chromosome):

L|M:

- Spherical cell **30 um** in diameter.
- Pale acidophilic granular cytoplasm (**yolk gran**)
- **Vesicular & eccentric** nucleus.
- Present at **prophase of the 1st meiotic division (mostly in diplotene stage).**

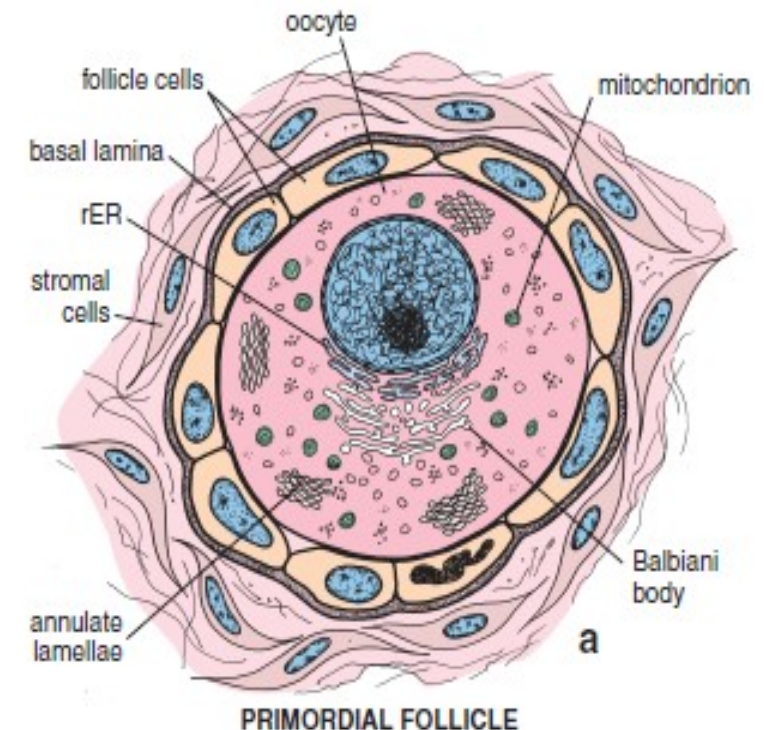


E|M: Numerous free ribosomes, mitochondria,

Golgi & RER (Why????)

II- Flattened follicular cells:

- Follicular cells are connected by *desmosomes*.
- Separated from surrounding C.T. by *B.L.*
- **At puberty** → growing follicle (1ry, 2ry).



✓ **At puberty, Changes in the follicles occur at 3 levels:**

1- Primary oocyte

2- Follicular cells

3- Surrounding stroma



2- Growing follicles

A- Primary follicle

- About 20-40 primordial follicles grow every cycle.

1) The oocyte ↑ in size (**120 um**) with ↑ in its organelles, secretes → **cortical granules** present under cell membrane (contains proteases).

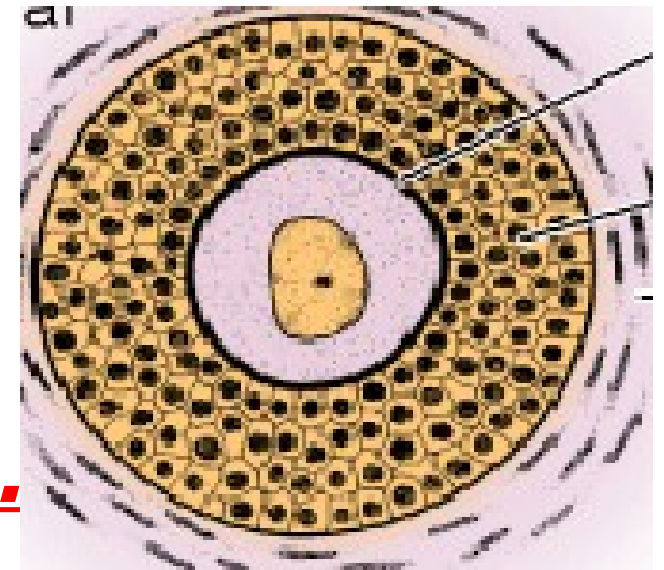
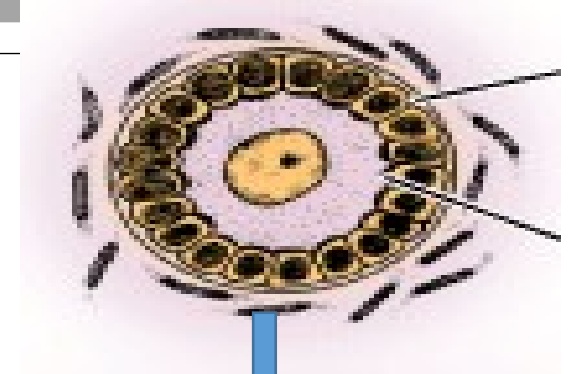
2) The follicular cells

a. ↑ in size → cubical then columnar → **(Unilaminar 1ry follicle)**.

b. Mitotic division → stratified layer of granulosa cells arranged as :

o Single columnar layer (**corona radiata**)

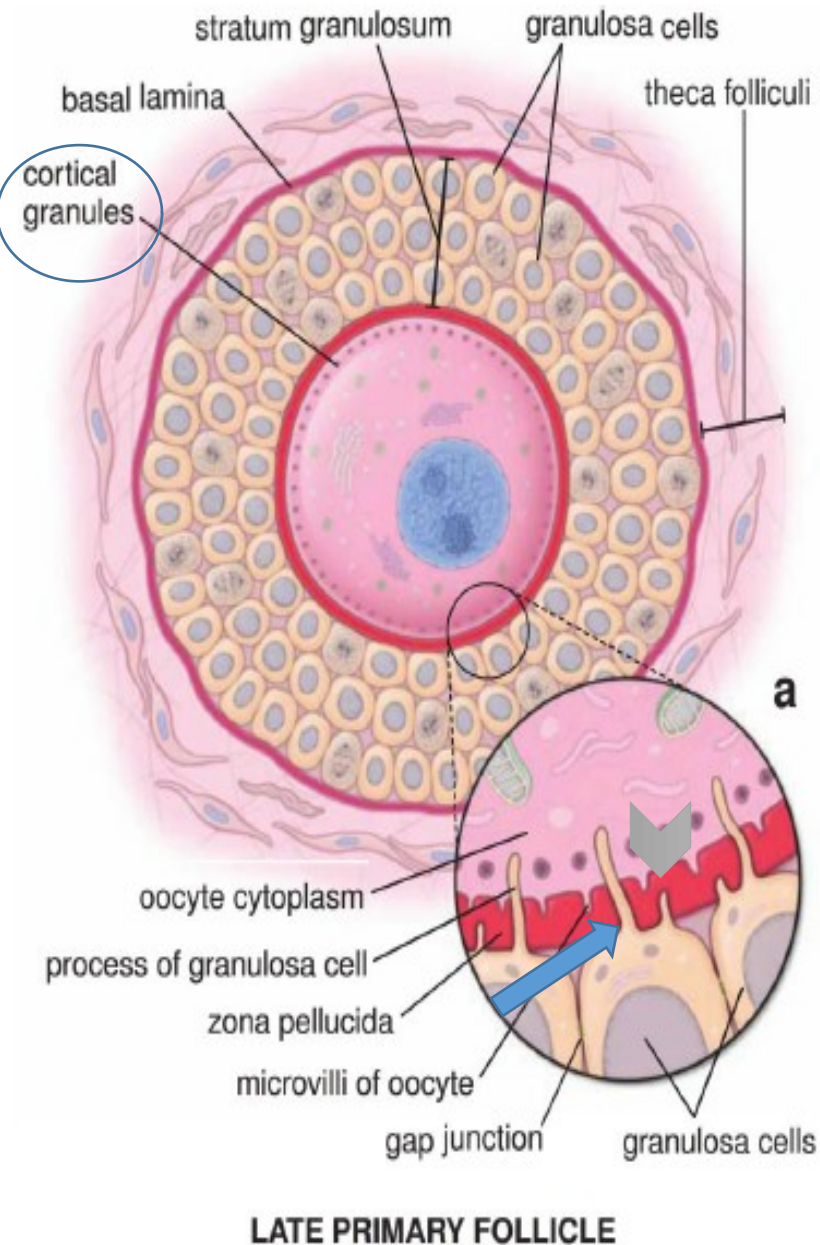
o Many layers of granulosa cells (gap junction) → **(Multilaminar 1ry follicle)**.



Primary Follicle

➤ Zona pellucida:

- It is a thick eosinophilic (PAS +ve) glycoprotein membrane.
- Synthesized by both *primary oocyte* and *granulosa*.
- It is traversed by microvilli of oocyte and processes of granulosa cells (*gap junction*) → for nutrition of oocyte.
- It includes glycoproteins named *ZP3* (*sperm receptor*).



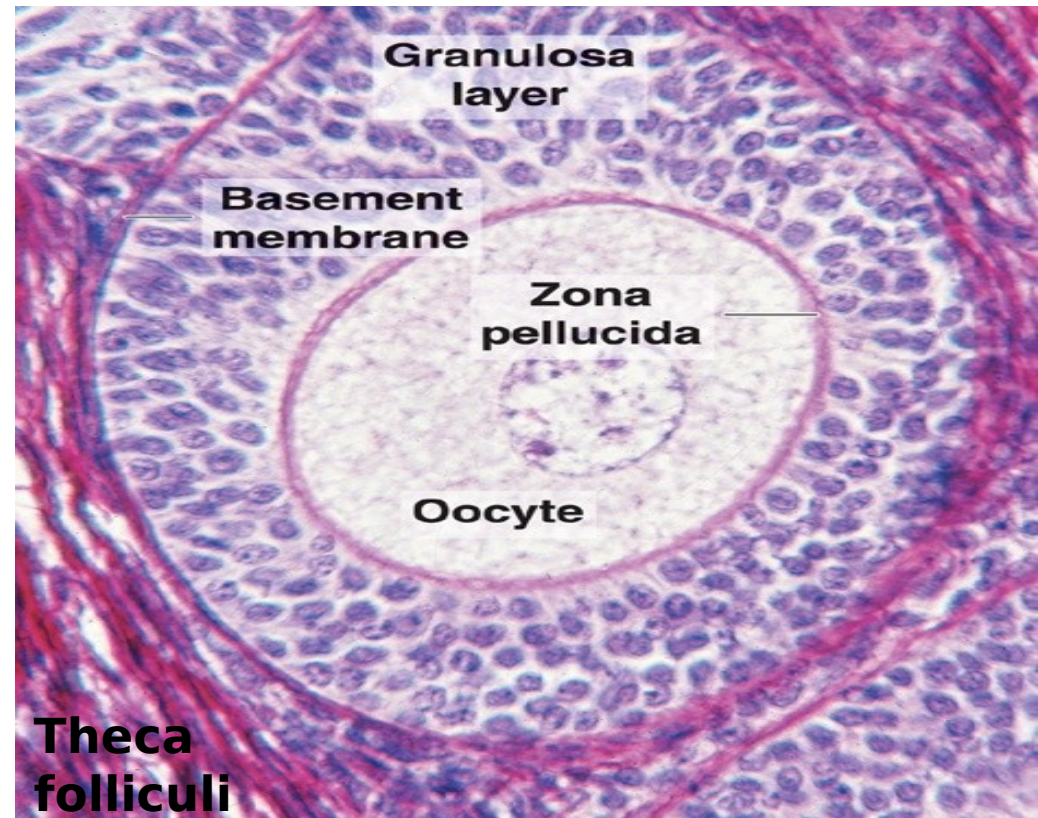
3) Theca folliculi (theca=box):

It is separated from granulosa cells by a thickened B.L. called *glassy membrane (WHY?)*

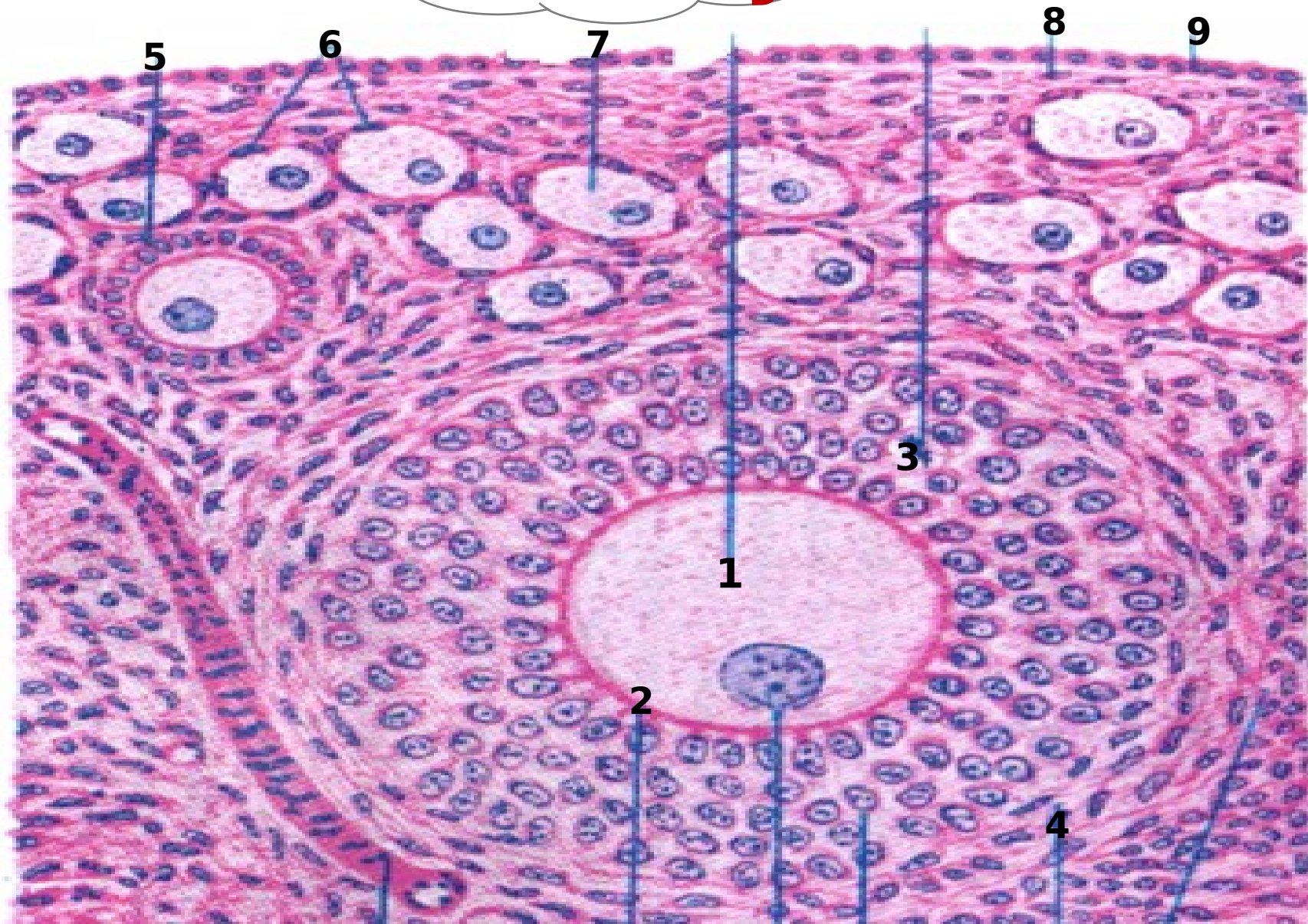
SEM of primary follicle



Multilaminar primary follicle



Activity



• Se

B. Secondary or antral follicle

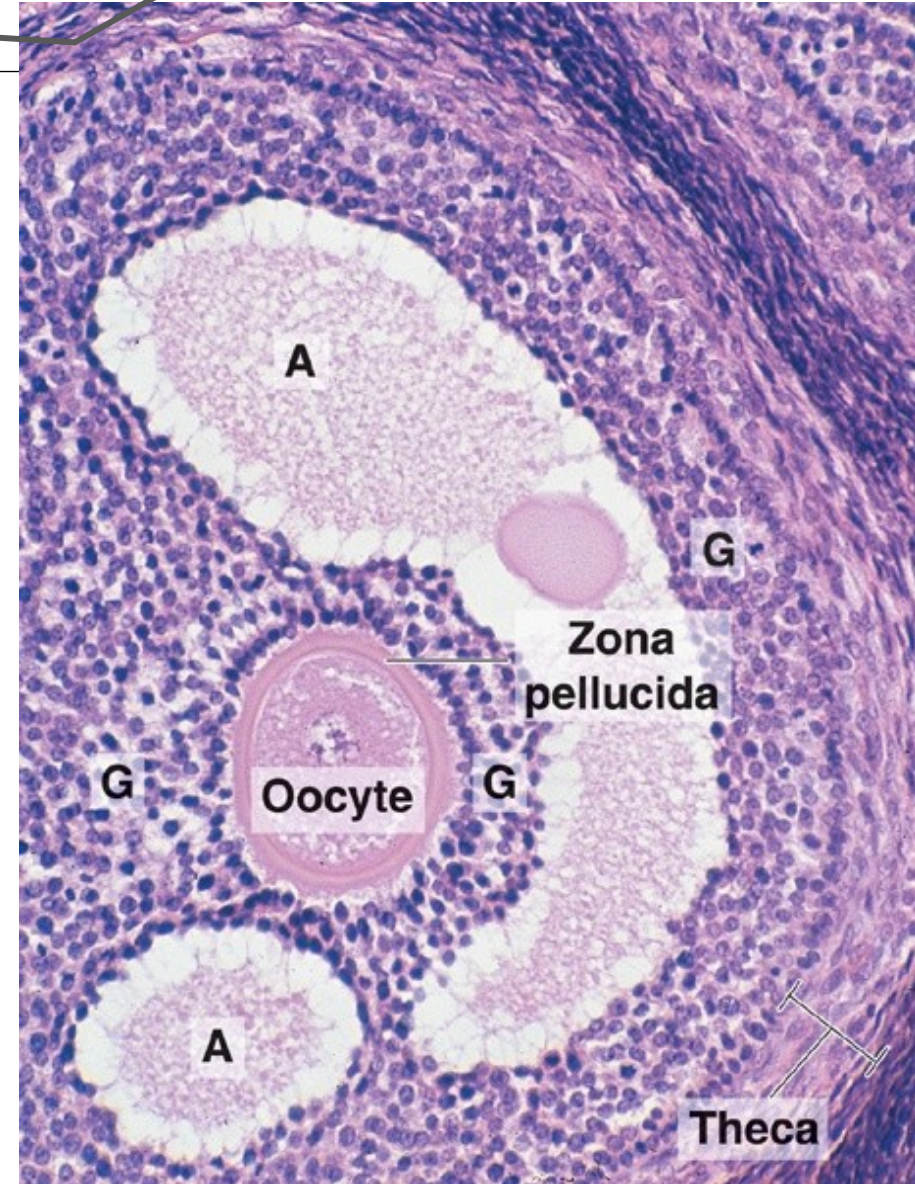
- FSH- Dependent

1- The oocyte→no further growth.

2- The granulosa cells → proliferate rapidly→ appearance of nutritive fluid in-between called **liquor folliculi** (mainly plasma, glycosaminoglycans and steroids).

This liquor accumulates to form cavity → **antrum**.

- **Corona radiata**: a layer of cubical cells surrounding the Z.P.



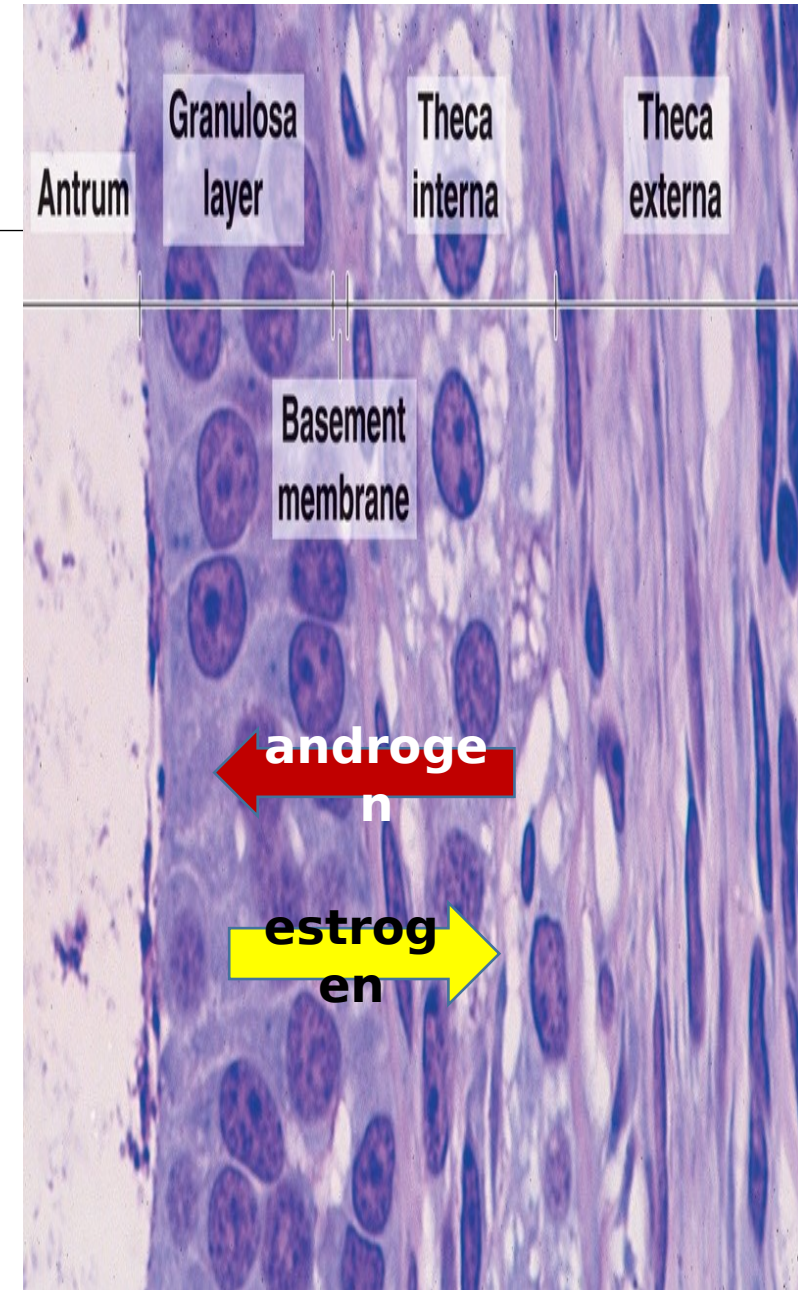
Secondary follicles

3- Theca folliculi differentiate into:

- **Theca externa**: smooth ms, fibroblasts, collagen fibers.
- **Theca interna**: cellular (rounded cells) & highly vascular.
- These cells by EM have all features of **steroid secreting cells**.
- They possess **LH receptor**.
- Theca interna cells secrete → **androgen** → diffuse through B.M → converted by granulosa cells into **estrogen** → by **aromatase** enzyme.

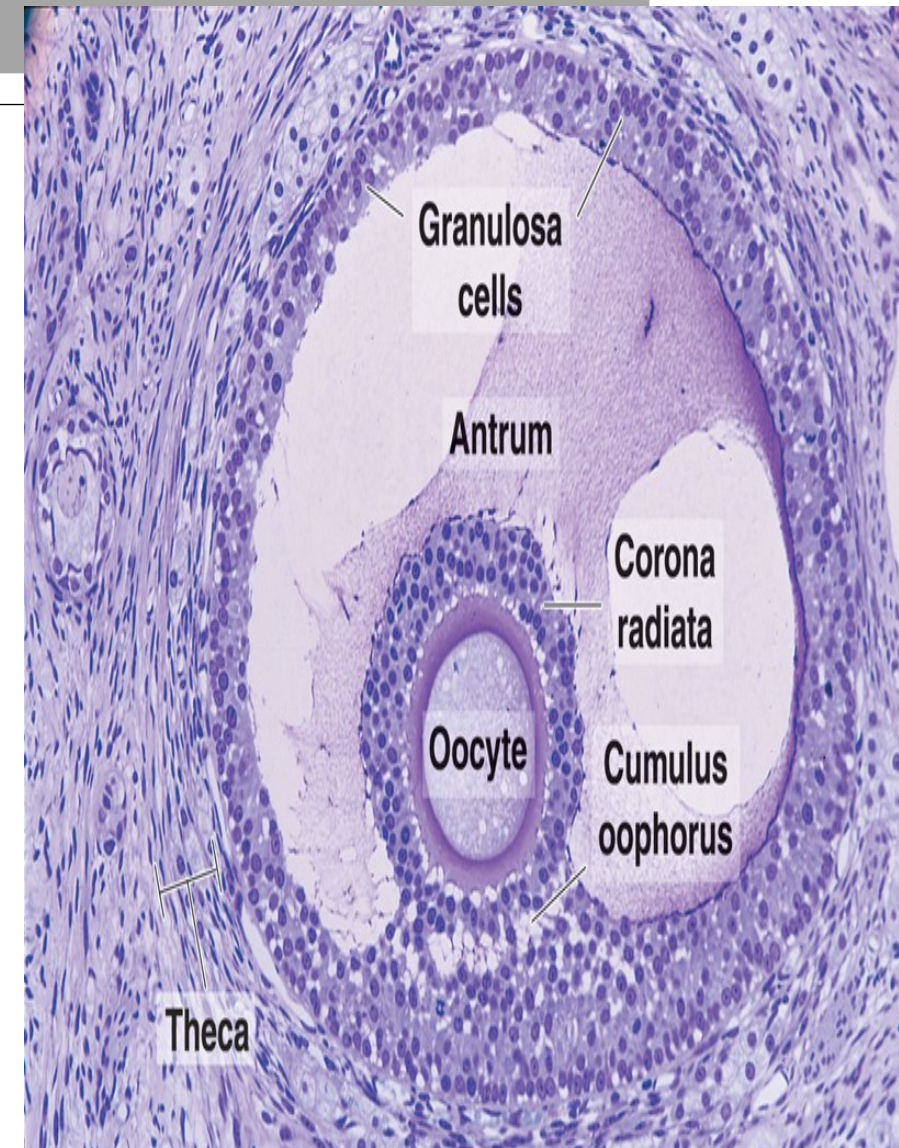
Fate:

- One follicle usually continue to grow
- While other follicles undergo atresia → **atretic follicles**.



3- Mature or Graafian follicles

- FSH-dependent
 - It is the largest follicle (1-2 cm) → bulge on the surface of the ovary.
- 1- The oocyte: 120µm. Detected by U/S
- Surrounded by Z.P.
 - Just before ovulation, **the 1st stage of meiosis is completed** → **secondary oocyte and 1st polar body**
- A. 1st polar body:** contains little cytoplasm and remains within the zona pellucida.
- B. The secondary oocyte (23d) proceed to metaphase of 2nd meiotic division** → **again arrested at metaphase until fertilization occurs.**



The Graafian follicle

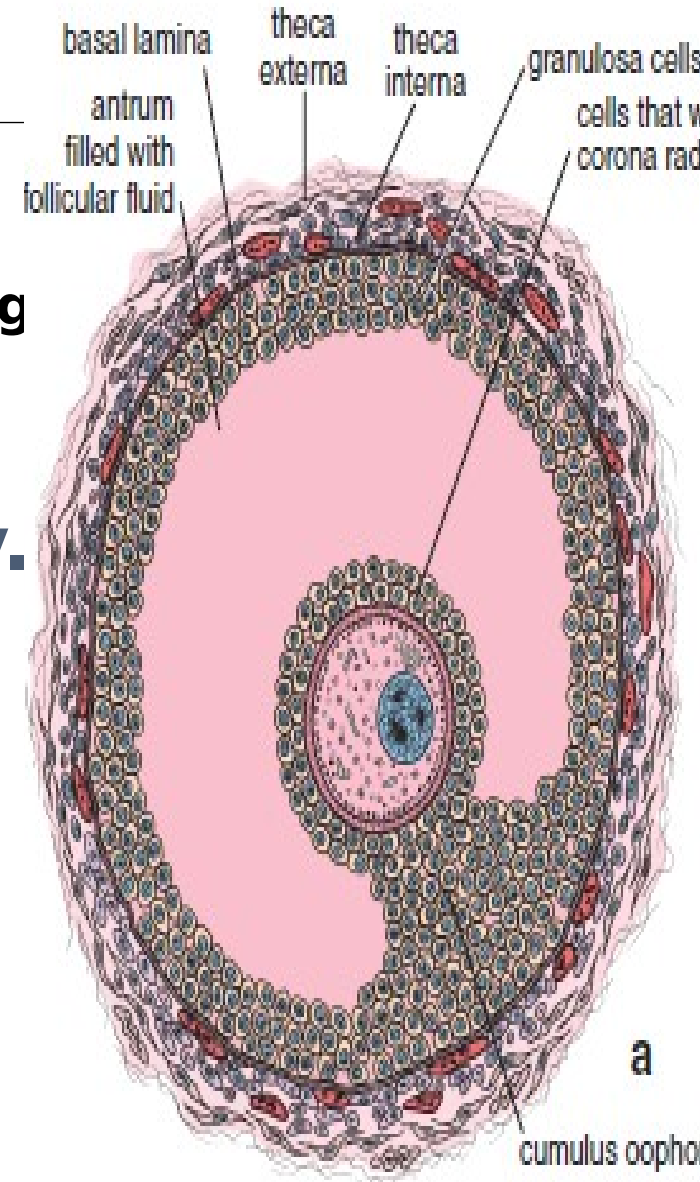
2- Granulosa cells forms:

- a. **Corona radiata** → columnar cells.
- b. **Cumulus oophorus** → group of cells surrounding oocyte at one side.
- c. **Membrana granulosa** → 3 or 4 layers of polygonal cells lining the follicular cavity.
 - B.M. (separate the *avascular granulosa cells* from *vascular theca interna*).

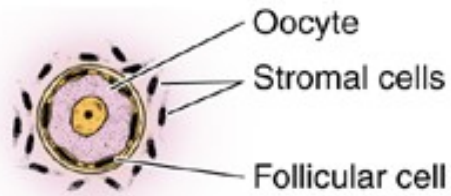
3- Theca folliculi

A- **Theca interna** : highly vascularized layer of cuboidal secretory cells.

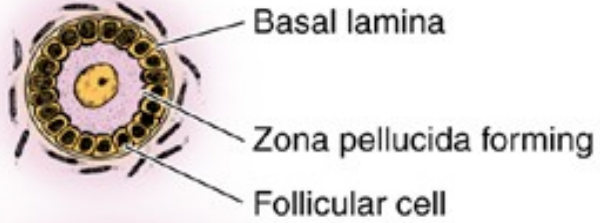
B- **Theca externa** (collagen fibers and smooth ms).



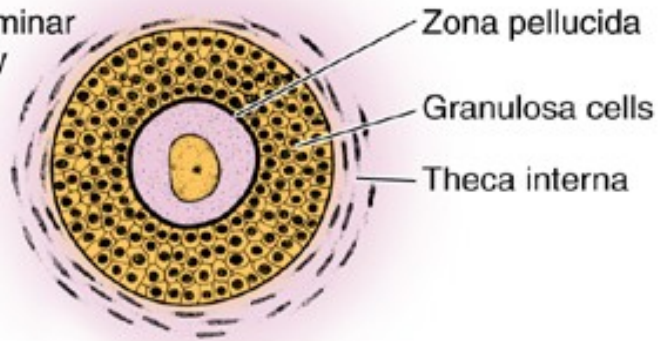
Primordial follicle



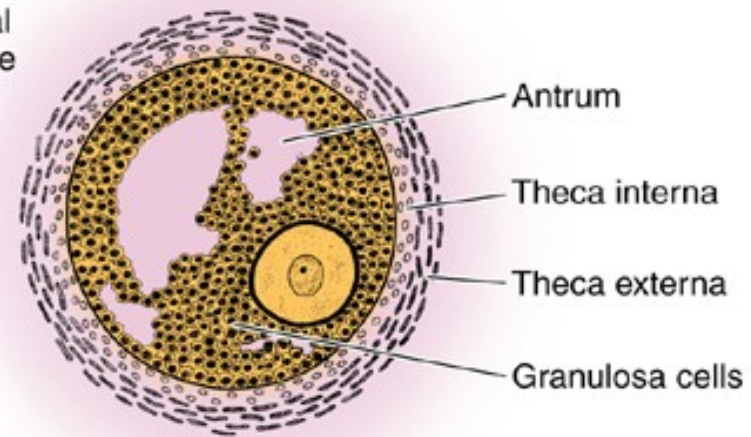
Unilaminar primary follicle



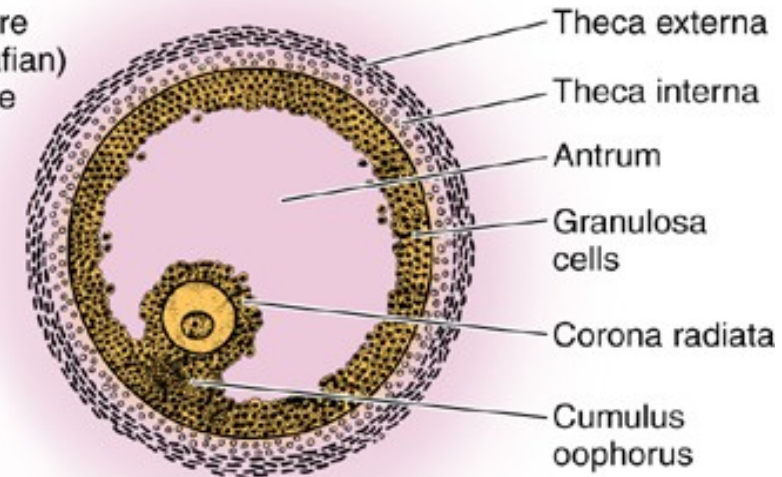
Multilaminar primary follicle



Antral follicle

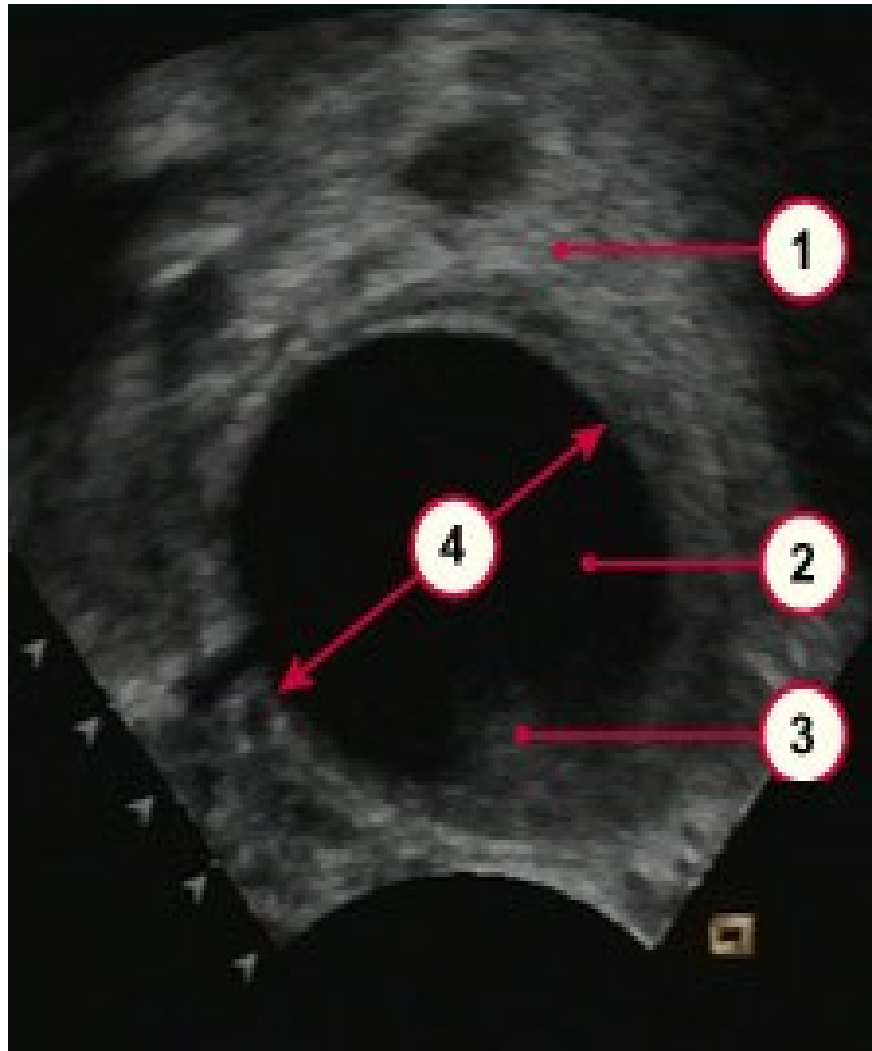


Mature (graafian) follicle

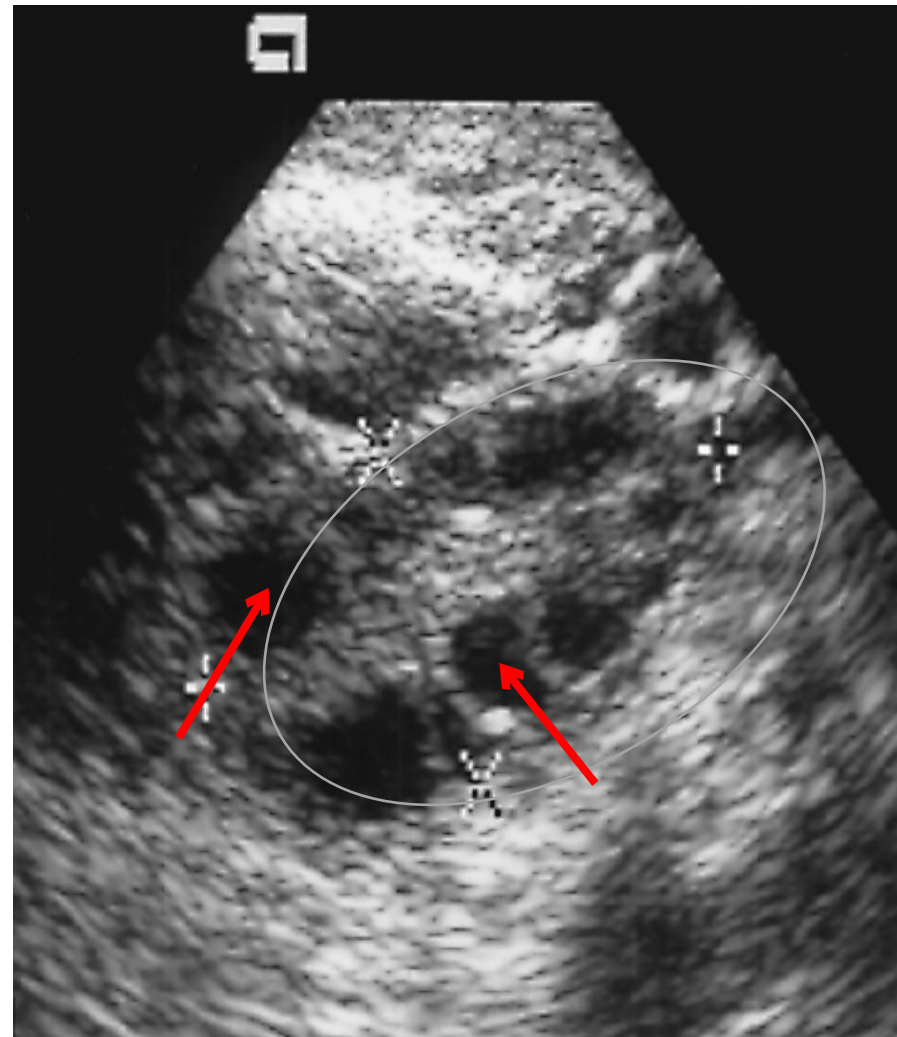


Ovarian follicles

**Ultrasound image
of Graafian follicle**



**Ultrasound image
of the ovary**



-
- **Which of the following biological processes accounts for the transformation of a primary to a secondary ovarian follicle?**

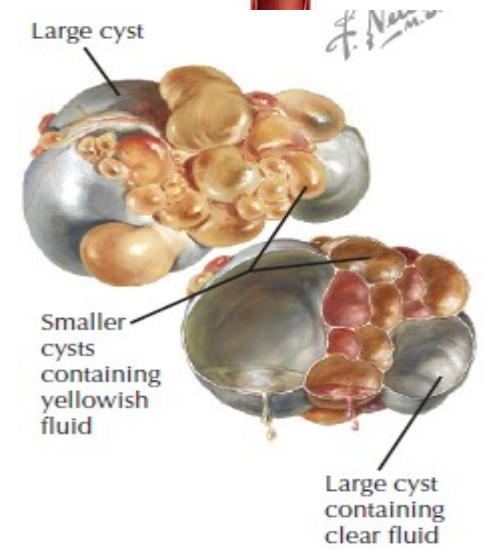
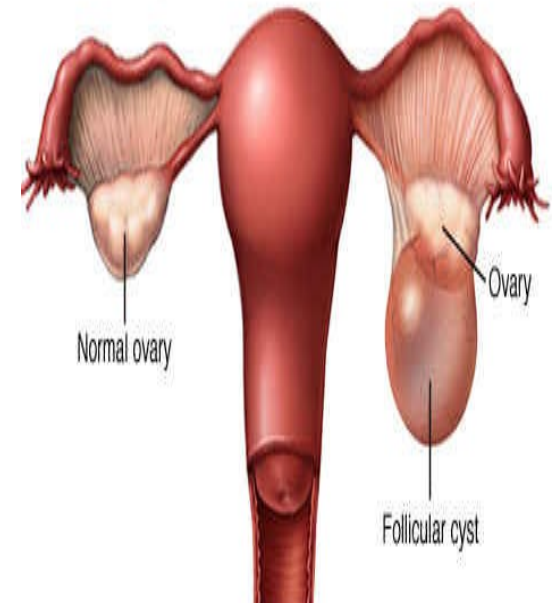
- (A) Deposition of the extracellular matrix**
- (B) Extracellular fluid accumulation**
- (C) Formation of a second polar body**
- (D) Maturation of the zona pellucida**
- (E) Proliferation of tissue macrophages**



Clinical Correlation

ovarian cysts

- Ovarian cysts are fluid-filled sacs or pockets within or on the surface of an ovary.
- *Types:*
- **Functional cysts** (disappear without treatment):
 - 1- **Follicular cyst** → thin -walled, fluid-filled structure.
 - 2- **Corpus luteal cyst**
- **Other cysts**
 - 1- **Dermoid cysts** → contain hair, skin or teeth, arise from cells that produce human eggs. They are rarely cancerous.
 - 2- **Cystadenomas** → filled with a watery liquid or a mucous material.
 - 3- **Endometriomas** → uterine endometrial cells grow outside uterus.

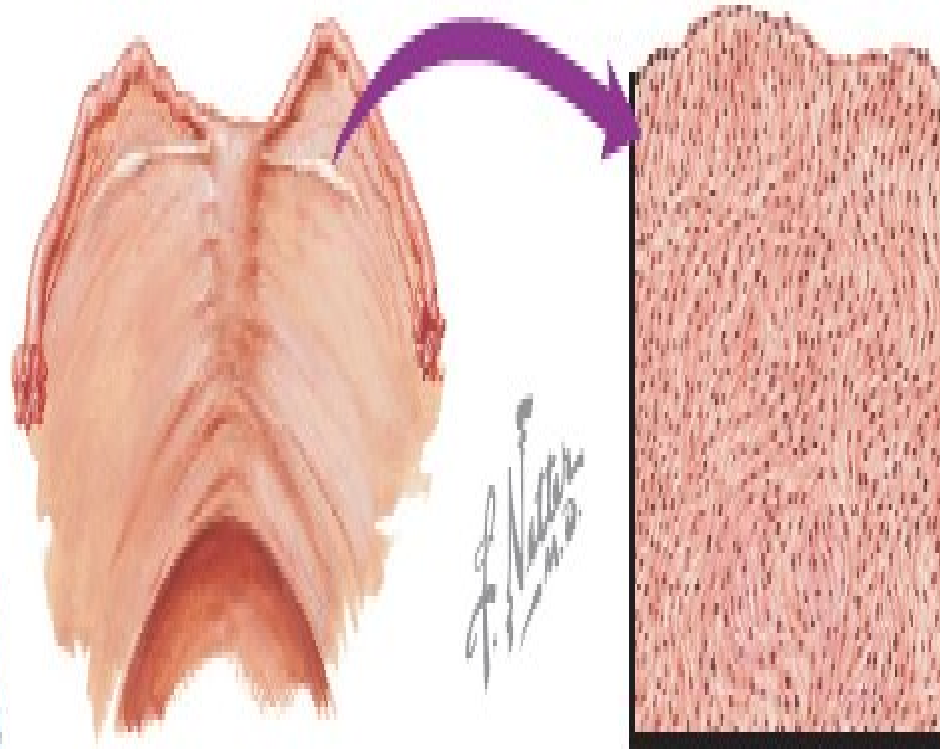


△ Ovarian cysts: multilocular serous cystadenoma.



➤ Turner syndrome:
ovarian agenesis.

Rudimentary ovaries or
primitive genital streaks



Microscopic section.
Complete absence
of oocytes and
ovarian follicles.

Follicle development and ovulation **(Animation)**

SUGGESTED TEXTBOOKS



1. **Junqueira's Basic Histology: Text and Atlas, 15th Edition by Anthony Mescher , 2018.**
2. **Michael H. Ross, Histology text and Atlas with correlated cell and molecular biology, 7th Edition, 2015.**
3. **Netter's Essential Histology, 2nd edition, 2013.**

